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REVISION OF THE K-ISOMER IN $^{190}\text{W}_{116}$ *

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Gamma rays from the decay of an isomer in $^{190}\text{W}_{116}$ have been observed following projectile fragmentation of a 1 GeV per nucleon ^{208}Pb beam. An earlier experiment indicated decay from a (10^-) isomer to the ground state rotational band. Improved statistics have enabled gamma coincidence and time-difference measurements to be made which alter the previous interpretation. Blocked BCS calculations have also been used together with reduced hindrance factors to indicate possible values of spin-parity for the isomer.

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1. Introduction

The neutron-rich nucleus ^{190}W is of some particular interest. Its experimental E_{4+}/E_{2+} ratio departs from the tendency of the lighter W isotopes to change smoothly from rigid rotor (ratio ~ 3.33) to triaxially symmetric rotor (ratio ~ 2.5) as the atomic number increases [1]. In addition, isomeric states related to possible oblate-prolate shape change as well as K-isomerism have been predicted for this nuclide [2].

2. Experimental setup

Heavy nuclear species around ^{192}W were populated in a relativistic projectile fragmentation reaction with a 2.5 g/cm^2 thick Be target bombarded by a $1\text{ GeV}/u$ ^{208}Pb beam at GSI, Germany. The typical on-target beam intensity was 1×10^9 Pb ions per 10 s spill, with 10–30 s between spills. The nuclei of interest were separated and identified using the FRagment Separator (FRS), operated in the standard achromatic mode with a wedge-shaped degrader of total thickness of 5420 mg/cm^2 Al equivalent in the intermediate focal plane. The nuclei were then slowed down in a variable thickness Al degrader and finally stopped in a 9 mm thick perspex stopper. The γ rays emitted by the stopped nuclei were detected by the high-efficiency RISING γ -ray spectrometer, consisting of 15 cluster Ge detectors of 7 crystals each, in a 4π arrangement, with a photopeak efficiency of 15% at 662 keV [3]. The delayed γ rays were recorded, allowing clean identification of isomeric decays. The time difference was measured between fragment implantation in the stopper and a subsequent γ ray, over a maximum range of $390\text{ }\mu\text{s}$.

3. Experimental results

The FRS setting was optimised for maximum transmission of ^{192}W . Around 20 000 fully stripped ^{190}W ions were implanted in the passive stopper at a rate of approximately 8 per minute. The delayed γ -ray spectrum associated with ^{190}W from the current work is presented in Fig. 1. The four gamma transitions of energies 206, 357, 483 and 693 keV, when corrected for detector efficiency and internal conversion, assuming an E2 character, have the same intensities within experimental error. All four γ rays and the characteristic tungsten K_α X-ray are in mutual and prompt ($\Delta t < 300\text{ ns}$) coincidence, as shown in Fig. 2. An additional 591 keV transition, with an intensity close to the observation limit, was observed in a previous fragmentation experiment [1, 4] and more recently using deep-inelastic reactions at Gammasphere [5]. The present experiment indicates a maximum possible branching ratio of: $I(591\text{ keV})/I(693\text{ keV}) < 10\%$. The most likely reason for the absence of the 591 keV transition in the present experiment is the ex-

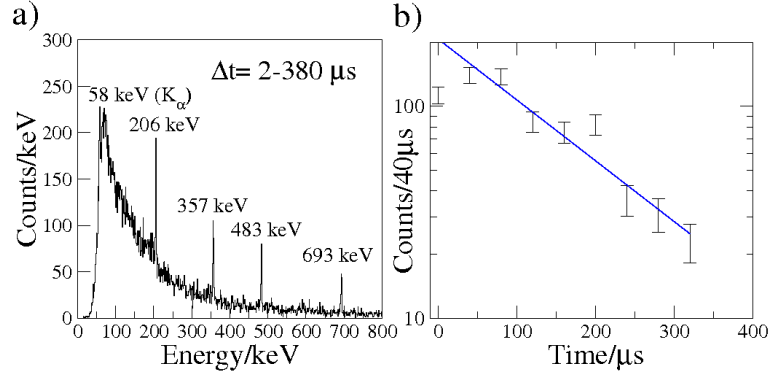


Fig. 1. (a) Delayed gamma-ray spectrum associated with ^{190}W . (b) Decay curve for the sum of the gamma transitions with line of best fit for 100–380 μs .

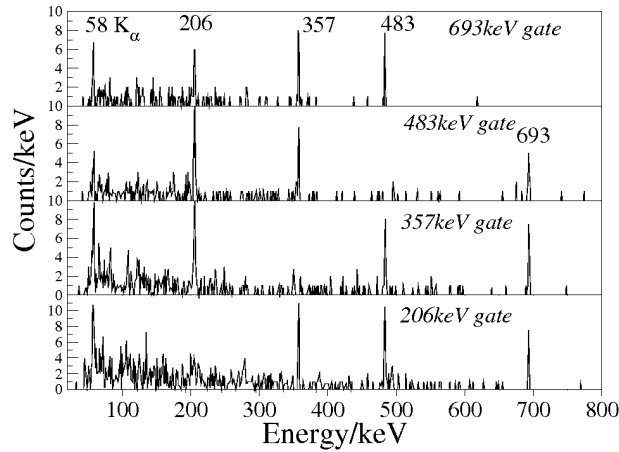


Fig. 2. Prompt ($\Delta t < 300$ ns) coincidence spectra obtained by gating on individual transitions.

istence of more than one isomeric state in ^{190}W . It is likely that the relative populations of these isomers depend on the reaction mechanisms employed. The decay curve in Fig. 1(b) indicates a rise during the first 100 μs ; the half-life, 105(22) μs , has been obtained by considering the 100–380 μs time range only. The half-life is consistent with that obtained in the previous fragmentation experiment, but with improved precision. The systematics of this mass region suggest that the 206, 357 and 483 keV transitions form a quasi-rotational cascade. The 206 and 357 keV transitions have been recently observed in the β -decay of ^{190}Ta [6] with intensities which confirm

that the 357–206 sequence corresponds to the $4^+ \rightarrow 2^+ \rightarrow 0^+$ cascade. If the 693 keV transition is interpreted as originating from the direct decay out of the isomeric state, the isomer would have an energy of 1739 keV.

Blocked BCS calculations, without residual interaction [7], were performed using deformation parameters $\epsilon_2 = 0.145$ and $\epsilon_4 = 0.056$, and pairing strengths $G_\pi = 22.50/A$ MeV and $G_\nu = 21.50/A$ MeV. The calculations indicate a number of possible candidates for the isomeric state, including states at 8^- and 8^+ with configurations of π $9/2[514] \otimes \pi$ $7/2[404]$ and ν $9/2[505] \otimes \nu$ $7/2[503]$ at energies of 2006 and 1812 keV respectively.

4. Summary and conclusions

In conclusion, we present an improved, high-statistics measurement of the isomeric decay of ^{190}W produced in projectile fragmentation. The data show no evidence for the previously reported 591 keV transition. The previous (10^-) spin-parity assignment for this isomer [8] is now disregarded in the light of improved data.

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